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Introduction

Organization and Charge

In 1999, the National Institute of Dental and Craniofacial Research (NIDCR) -- with input from the NIDCR National Advisory Dental and Craniofacial Research Council -- appointed a fifteen-member Blue Ribbon Panel on Research Training and Career Development to Meet Emerging Scientific Opportunities of the 21st Century. Chaired by Dr. Charles Bertolami, University of California, San Francisco, and Dr. Joseph Martin, Harvard Medical School, the Panel represented a range of scientific disciplines, roles, institutions and perspectives. The charge to the Blue Ribbon Panel was clear:

> The Panel is charged to identify the major emerging scientific opportunities of the 21st Century and to recommend the competencies required by investigators to pursue those opportunities.

Specifically, the Blue Ribbon Panel was asked to consider two overarching questions:

1) What are the most exciting scientific opportunities that have emerged in recent years or that we may anticipate in the next few decades?

2) What new skills and competencies must scientists acquire in the coming years in order to respond to emerging or anticipated scientific opportunities?

The Blue Ribbon Panel met on July 27 and 28, 1999, at the National Institutes of Health in Bethesda, Maryland. In his opening remarks, Dr. Harold Slavkin, Director of the National Institute of Dental and Craniofacial Research, observed that the meeting provided an opportunity to focus on the "central issue" for all of the National Institutes of Health, namely to identify the competencies essential to address the compelling health-related issues of the next century.

> "Candidly, the amount of theories and concepts and factoids…that each of us confronts in our own professional and personal lives is overwhelming. The world is changing at a rate more rapid, more dynamic perhaps, than ever before in human history…I think all of you fully appreciate that every Institute, every Center, and every Office at the NIH, probably every major university in the country, every major industry, as well as Federal and State governments are all trying to get a handle on the competencies that require immediate attention. That is, how can we acculturate people to get comfortable with 'reinvention' and so-called 'life-long' learning required for their professional development in the next millennium?
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> "While all of this is going on, we also have a dynamic that is very formidable…There is a tension between the private sector and those of us trying to train for the next century in which we are competing for a limited pool of the brightest health scientists – in medicine, in dentistry, in pharmacy, in nursing and the behavioral sciences."

Dr. Slavkin urged the Blue Ribbon Panel to consider ways that the Institute could become "more effective" in its efforts to recruit, train and retrain specialists with the skills that will be needed to participate in the wonderful scientific opportunities of the next century.

NIDCR Research Training and Career Development Efforts

The National Institute of Dental and Craniofacial Research has been involved in research training and career development activities from the very earliest days of the Institute. In Fiscal Year 1999, approximately six percent of the Institute's budget was devoted to extramural research training and career development activities. More than $8 million was spent on over 80 institutional and individual awards supported through the various mechanisms of the National Research Service Awards (NRSA) authority. Over 400 trainees participated in these programs, which were located at more than 30 academic health science institutions throughout the United States.

Specific NRSA mechanisms directly supported by the NIDCR include the Individual Predoctoral Dental Scientist Fellowship (F30), the Individual Postdoctoral Fellowship (F32), the Individual Senior Fellowship (F33), the Institutional Training Program (T32), the Dental Scientist Training Program (T32), the Institutional Short-Term Training Program (T35), and the Institutional T35 award for dental students from underrepresented minority backgrounds, women, and students with disabilities (T35).

The other major type of mechanism used to support training is the Career Development Award (CDA). In Fiscal Year 1999, the NIDCR also spent nearly $6 million to fund more than 90 dentists and physicians for training through institutional and individual CDA awards as well as several others that were co-funded with the NIH Institutes and Centers or other Federal Agencies. Specific CDA mechanisms supported by the NIDCR include the Institutional Dentist Scientist Award (K16), the Independent Scientist Award (K02), the Mentored Clinical Scientists Development Award (K08), the Mentored Patient-Oriented Research Career Development Award (K23), and the Midcareer Investigator Award in Patient-Oriented Research (K24). These supported more than 100 individuals and were located at 20 health science institutions in the United States. The majority of individuals being trained through the NRSA and CDA mechanisms were dentists enrolled for the PhD degree. Additional trainees had the PhD or MD degree and were involved in postdoctoral experiences, or were predoctoral students either in dental schools or in pursuit of the PhD degree.

The NIDCR continually seeks to improve its research training and career development programs to assure that the Institute's training activities produce the types of research personnel needed to address the most critical basic, behavioral and clinical research areas of the coming decades. In consultation with the National Advisory Dental and Craniofacial Research Council, NIDCR staff reviewed suggestions for program enhancements in research training from a number of sources, including the Institute of Medicine and the National Research Council.[1] In addition, the NIDCR has paid special heed to the recommendations for training contained in the report of the NIH Director's Panel on Clinical Research to the Advisory Committee of the NIH Director.[2]

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[1] Reports reviewed in recent years by NIDCR staff include: NRC, Meeting the Nation's Needs for Biomedical and Behavioral Scientists, Washington, DC: National Academy Press, 1994; Kelley, WN and JA Randolph (Eds.), Careers in Clinical Research, Washington, DC: National Academy Press, 1994; Field, MJ (Ed.), Dental Education at the Crossroads: Challenges and Change, Washington, DC: National Academy Press, 1995; and NIDR, "Blue Ribbon Panel on Envisioning the Future of the NIDR Intramural Research Program," Office of the Director, Bethesda, MD, March 1993.

[2] NIH, NIH Director's Panel on Clinical Research Report to the Advisory Committee to the NIH Director, December 1997. http://www.nih.gov/news/crp/97repeort/index.htm.

The NIDCR has responded to these various reports in several ways. For example, the Institute has developed such training programs as the Institutional Dental Scientist Training Program (DSTP) and the Individual Predoctoral Dental Scientist Fellowship through which dental students may obtain the dental and PhD degrees while having most of their tuition (and many other educational training expenses) paid by the NIDCR. Such an arrangement decreases or, in some cases, eliminates trainees' indebtedness. The NIDCR also has modified its institutional NRSA Short-Term Training Program award so that individuals admitted to professional school can be supported to begin their research experiences prior to enrolling in dental or medical school and continue them throughout their professional school career.

The NIDCR collaborates with many Institutes and Federal Agencies to foster research training and career development opportunities. For example, the NIDCR is co-funding several programs with the National Center for Research Resources (NCRR, NIH) that enable students to obtain enriched programs in science education, especially when they are from underrepresented minority and diverse populations in grades kindergarten through high school. Other training activities co-funded by the NIDCR that address the spirit of the recommendations from the aforementioned reports include support of programs in bioinformatics (with the National Library of Medicine, NIH), international AIDS research training (with the Fogarty International Center, NIH), undergraduate minority students (the Minority Access to Research Careers -- MARC -- program with the National Institute of General and Medical Sciences, NIH), programs for training in predoctoral neuroscience, bioethics, and the development of clinical research curriculum (co-funded with many other NIH Institutes), and health services research (with the Agency for Healthcare Research and Quality).

The NIDR Strategic Plan

In 1997, the National Institute of Dental Research (NIDR)[3] released a report that presented to the public a plan for advancing dental, craniofacial and oral health science to meet the needs of a complex and changing society. That Strategic Plan served as an important starting point for Blue Ribbon Panel discussions.

In developing the plan, the authors noted that significant changes had taken place in the organization and content of science in the United States.

> "The life sciences have become a political, social and economic force. They have created new industries, forged new alliances and established new cross-disciplinary and interdisciplinary fields of study. Research has become a complex, team-driven enterprise, exploiting and inventing powerful new techniques and instruments that have fundamentally altered the way we do science. In this new era, 'health' is not defined as the absence of disease, nor is 'disease' an abstract malfunction of a body part or system. Instead, both are seen in the context of a unique individual whose health status is influenced by environmental, cultural, social, behavioral and biological variables." NIDR Strategic Plan, pp. 3 – 4, 1997.

The Plan traced the growth of craniofacial, oral, and dental sciences over the preceding half century, that is, since the Institute's creation in 1948. One immediate result of the strategic planning process was the need for a name change to reflect the scope of research, training, and health promotion activities of the Institute. Also, there was a need to reorganize the Institute's Division of Extramural Research (DER) and Division of Intramural Research (DIR). The divisions were aligned "to more accurately reflect the major opportunities in craniofacial, oral and dental sciences today and our expectations for the near future" (p. 12). The new extramural program areas and intramural branches are now clustered around the following themes:

[3] In 1998, the Institute was renamed the "National Institute of Dental and Craniofacial Research" (NIDCR).

Inherited Diseases and Disorders. This includes research on disfiguring birth defects and dysfunctional organs and systems of the craniofacial complex.

Infectious Diseases and Immunity. Early on, the Institute established the bacterial nature of both dental and periodontal diseases. Since that time, studies have grown to encompass other oral pathogens and interaction of oral flora with host tissues. More recently, sequencing of the genomes of oral pathogens will enable researchers to determine the key genes that determine a microbe's virulence…a major step toward the development of "smart" therapies.

Neoplastic Diseases. Research findings have highlighted the role of oncogenes and tumor-suppressor genes. NIDCR supports head and neck cancer centers and grants, which address basic, translational, patient-oriented, and community-based research on the "etiology, pathogenesis and metastasis, epidemiology, prevention, diagnosis and treatment of these cancers."

Chronic and Disabling Diseases. Changing demographics with significant gains in the number of mature and older-aged groups have led the Institute to target scientific opportunities relevant to chronic and disabling diseases. Beyond the Institute's well-established research on the body's connective and mineralized tissues, major opportunities are related to osteoporosis, osteoarthritis, and other bone and joint diseases.

Biomaterials, Biomimetics, and Tissue Engineering. Research in this area is aimed at using the body's own molecules and processes in rebuilding tissues, thus avoiding the introduction of restorative materials into the body. The discovery of cytokines, growth factors, and numerous extracellular matrix molecules have given rise to a revolutionary approach to repair and regenerate body tissues.

Behavior, Health Promotion and Environment. Under this broad theme, the Institute supports basic, patient-oriented and community-based research aimed at assessing the interactive roles of behavioral, sociological, economic, environmental, genetic and other biological factors in craniofacial, oral and dental diseases.

The Institute's Strategic Plan identified three specific initiatives: (1) research opportunities, (2) research capacity, and (3) health promotion. These initiatives were designed to position the Institute to explore exciting new possibilities for research and service to the NIDR community -- consisting of "academic, private sector, and Federal organizations; professional and patient groups; health care providers; 'our NIDR staff;' and the public at large, domestically and globally" (NIDR, 1997, p. iii).

The Blue Ribbon Panel on Research Training and Career Development was asked to review these strategic initiatives in light of anticipated scientific opportunities of the 21st Century and their implications for research personnel. The Panel's recommendations for enhancing Institute activities in these areas are described in Chapter 4 of this report.

Each of the three "strategic initiatives" is summarized below:

Strategic Initiative I

Research Opportunities

"We will identify, set priorities and implement scientific opportunities to advance each of the six major areas of the NIDR portfolio: inherited diseases; infectious diseases; neoplastic diseases; chronic and disabling diseases and disorders; biomaterials, tissue engineering, and biomimetics; and oral health promotion and disease prevention." NIDR, Strategic Plan, p. 19, 1997.

Goal A: Develop an ongoing and flexible process to set priorities for investment in areas of scientific opportunity.

Goal B: Strive toward balance in the research portfolio by promoting basic, translational, patient-oriented and community-based research in the selected areas of opportunity.

Goal C: Enhance applications of research to preventive, diagnostic and therapeutic measures.

Strategic Initiative II
Research Capacity

"The enhancement and innovative development of human, physical and technological resources is essential to the realization of scientific opportunities. These resources provide the critical personnel and infrastructure for the creative conduct of research." NIDR, Strategic Plan, p. 23, 1997.

Goal A: Enhance training and career development programs to attract and retain exceptional individuals in craniofacial, oral and dental research.

Goal B: Develop physical and technological resources aimed at facilitating and accelerating research conduct, in collaboration with NIH Institutes, Centers and Divisions, and other organizations.

Strategic Initiative III

Health Promotion

"The NIDR is positioned to serve as a national catalyst for promoting science-based activities that will accelerate improvements in craniofacial, oral and dental health. Promotion of health and prevention of diseases and disorders remains a major centerpiece of the Institute." NIDR, Strategic Plan, p. 25, 1997.

Goal A: Assess and enhance the Institute's capacity to serve as a national resource for promoting science-based health promotion activities.

Goal B: Enable stakeholders to use the science base to promote health.

Goal C: Increase the capacity to assess and be more responsive to changing health needs and disease trends.

The building blocks for the Institute's success include human resources, communications, effective management practices, and information technology managements.

Goal A of Strategic Initiative II, which addresses research training and career development in particular, included the following objectives:

- Develop and implement innovative strategies to recruit, train and re-train individuals and teams.
- Foster postdoctoral training programs that emphasize mentoring, institutional environments and resources, creative curricular design, faculty roles, expected competencies, and student support activities.
- Increase the number of scientists with expertise in cellular and molecular biology, human genetics, structural biology, computational biology, molecular epidemiology, diagnostic sciences, informatics, behavioral and social sciences, health services, and clinical research.
- Facilitate the participation of women, ethnic and racial minorities, and individuals with disabilities in research.

Background Readings

To facilitate Panel discussions, staff compiled an extensive set of articles about health-related research and training in advance of the meeting. These readings included articles from such publications as Science, Scientific American, Annals of the New York Academy of Science, The Pharos, and the Journal of the American Dental Association, as well as papers and reports from

various NIH Institutes, the National Academy of Sciences, the Institute of Medicine, and other sources. The complete reference list can be accessed through the NIDCR Research Training homepage (at www.nidcr.nih.gov).

Invited Testimony

A number of organizations have mounted new strategies to recruit, train, and retrain talented specialists. To enrich the deliberations of the Blue Ribbon Panel, individuals from a variety of settings, including Federal agencies, private sector organizations, professional societies, university-based programs, as well as training and career development program directors and trainees, were invited to describe their experience in meeting the talent needs of the 21st Century.

Their views are summarized in Chapter 3 and presented in greater detail in Appendix A.

Structure of the Blue Ribbon Panel Report

During its two days of deliberations, the Blue Ribbon Panel had the opportunity to identify and discuss many important insights into the frontiers of science and technology. The product of their deliberations is a series of recommendations to the National Institute of Dental and Craniofacial Research. These suggestions – detailed in the final chapter of this report – address issues related to the future availability and training of scientists who will advance dental, craniofacial and oral health research. These observations reflect the best judgment of the Panel based on their experience, on their reading of selected background documents, and on the testimony of the invited speakers.

Appendix A presents an edited summary of the remarks of each invited speaker. The program for the Blue Ribbon Panel meeting may be found in Appendix B.